WT-608 (EX)
EXTRACTED VERSION

AD-A995 267

OPERATION IVY

REPORT OF COMMANDER, TASK GROUP 132.1

Pacific Proving Grounds

Joint Task Force 132

November 1952

NOTICE

This is an extract of WT-608, which remains classified SECRET/RESTRICTED DATA as of this date.

Extract version prepared for:

Director

DEFENSE NUCLEAR AGENCY

Washington, D. C. 20305

31 October 1984

Approved for public release; distribution unlimited.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER WT-608 (EX)	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) OPERATION IVY, REPORT OF COMMANDER, TASK GROUP 132.1		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER WT-608 (EX)
7. AUTHOR(s) Stanley W. Burriss		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Los Alamos Scientific Laboratory Los Alamos, New Mexico		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE November 1952 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; unlimited distribution.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This report has had the classified information removed and has been republished in unclassified form for public release. This work was performed by Kaman Tempo under contract DNA001-83-C-0286 with the close cooperation of the Classification Management Division of the Defense Nuclear Agency.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Operation IVY

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The mission of the Task Group included the responsibilities to conduct experimental measurement programs on Shots Mike and King and to conduct the radiological safety program. Programs were established to make radiochemical analysis of bomb debris; to follow the progress of the nuclear reaction; to make neutron, gamma ray, blast, thermal radiation, and electromagnetic measurements; and to make a preliminary geophysical and marine survey of the test area. The organizational structure and command relations to accomplish the mission are outlined.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

FOREWORD

This report has had classified material removed in order to make the information available on an unclassified, open publication basis, to any interested parties. This effort to declassify this report has been accomplished specifically to support the Department of Defense Nuclear Test Personnel Review (NTPR) Program. The objective is to facilitate studies of the low levels of radiation received by some individuals during the atmospheric nuclear test program by making as much information as possible available to all interested parties.

The material which has been deleted is all currently classified as Restricted Data or Formerly Restricted Data under the provision of the Atomic Energy Act of 1954, (as amended) or is National Security Information.

This report has been reproduced directly from available copies of the original material. The locations from which material has been deleted is generally obvious by the spacings and "holes" in the text. Thus the context of the material deleted is identified to assist the reader in the determination of whether the deleted information is germane to his study.

It is the belief of the individuals who have participated in preparing this report by deleting the classified material and of the Defense Nuclear Agency that the report accurately portrays the contents of the original and that the deleted material is of little or no significance to studies into the amounts or types of radiation received by any individuals during the atmospheric nuclear test program.

CONTENTS

CONTENTS (Continued)

Page

CONTENTS (Continued)

ILLUSTRATIONS

TABLE

CHAPTER 1

DEVICES TESTED

1.1 MIKE DEVICE

1.1.1 Objective of Detonation

The objective of Mike Shot was to test, by actual detonation, the theory of design for a thermonuclear reaction on a large scale, the results of which test could be used to design, test, and produce stockpile thermonuclear weapons.

1.1.4 Yield

In order to be assured that a thermonuclear reaction progressed to a desired magnitude, the Mike device was essentially overdesigned. The yield of this device is considered to be within the range of 6 to 12 Mt. A better yield figure is not available at the date of writing, pending a more complete analysis of test data.*†

---

*Application of the LASL analytic solution method to the EG&G photographic data has resulted in the following as the fireball yield figure as of May 15, 1953: Mike, 11 ± 1 Mt; King, 550 ± 20 kt.

†See note on p. 14.

1.1.5 Remarks

It is desirable to point out that the thermonuclear device tested was not a weapon. All the diagnostic experiments were designed to measure certain specific reactions in an effort to confirm the predictions of theories that went into the design of this device. This type of thermonuclear device may be adaptable to a major redesign for weapon purposes. It is believed that the over-all size and weight can be reduced and that the cryogenics system can be simplified to make a usable weapon. It is hoped that a new design will be ready for overseas tests in the spring of 1954.

1.2 KING WEAPON

1.2.1 Objective of Detonation

The objective of King Shot was to

Data on the field variables leading to consideration of weapon effects in this yield range were also desired.

1.2.5 Yield

The preliminary estimates of yield are given by radiochemistry as 550 ± 50 kt, whereas the photographic analysis indicates the yield to be 570 ± 30 kt. It therefore seems probable at this time that the yield for King Shot lies in the range of 530 to 600 kt.

1.2.6 Remarks

Within the limitations of the basic design of the present pit, this test demonstrated the immediate high-yield capabilities of King Shot provided valuable information on thermal, blast, and radiation effects from high-yield fission weapons.

CHAPTER 2

SUMMARY OF EXPERIMENTAL PROGRAMS

2.1 PROGRAM 1, RADIOCHEMISTRY

The objective of this program was the collection and radiochemical analysis of bomb debris samples, the primary purpose of the analysis being the determination of yield. Also, for Mike Shot, an attempt was made to obtain pertinent diagnostic information (whether or not, and to what extent, the desired thermonuclear reaction took place and propagated, etc.) by means of further analysis designed to detect activity in selected tracer materials

quantities of which were built into, or placed in the vicinity of, the device.

The quantity of gaseous and particulate bomb debris samples collected from the detonation-induced clouds, utilizing collectors mounted on manned F-84G aircraft, was adequate. The aircraft were based on Kwajalein and required in-flight refueling to accomplish their mission. Shielded flight clothing was worn by the pilots of these aircraft to reduce radiation exposure. The clothing seems to have been effective in some cases, indicating that low-energy gamma radiation was present in the cloud during some penetrations. The radiation exposures received by these pilots were in all cases well within the prescribed limits.

Laboratory analysis was not complete at the time of writing and is being done at the Los Alamos Scientific Laboratory (LASL). Preliminary results are: Mike Shot, 5 to 7 Mt; King Shot, 550 ± 50 kt. The discrepancy between this yield result for Mike Shot and that given by ball-of-fire photography (see Sec. 2.3) has not yet been resolved. At present, however, it appears that the ball-of-fire result is more reliable. (See note on p. 14.)

2.2 PROGRAM 2, PROGRESS OF THE NUCLEAR REACTION

This program was designed to document the performance of the devices tested, utilizing various diagnostic measurements. New and untested experimental techniques were used on Mike Shot; hence the large amount of data obtained is very gratifying. For Mike Shot, measurements were made of the alpha (logarithmic rate of rise of the nuclear reaction) of the

reaction to the beginning of the thermonuclear reaction,

the rate of propagation of the thermonuclear reaction, and the energy spectrum of the neutron flux. The data for these measurements were recorded in a concrete bunker which was 9000 ft from the device and was connected to the cab by a helium-filled tunnel, through which gamma-ray and neutron signals could pass with little attenuation. For King Shot, alpha and transit time (the time from the firing signal to the first nuclear reaction) were measured, the latter by a remote-measurement technique capable of tactical utilization.

2.3 PROGRAM 3, SCIENTIFIC PHOTOGRAPHY

This program had many objectives, each of which involved photographic documentation of some aspect of the detonations. Fireball growth, cloud development, and illumination vs time were measured for both shots. For Mike Shot and the crater structure were documented, and

. For King Shot the precise position of the burst was measured. In addition, bhangmeters (detection of fireball light) were utilized for both shots. These instruments were designed to obtain a remote and quick yield result from light-signal observation.

Generally speaking, three camera types were used to accomplish the photographic objectives, one type producing a record made up of a number of discrete photographs (or frames), another producing a continuous streak record, and a third producing a single picture at a known time after zero. Depending on the phenomenon being photographed, film speeds from 16 frames/sec to $3^1/_2$ million frames/sec were utilized.

Many data were obtained in spite of isolated equipment failures. Most of the film records have yet to be completely analyzed, but preliminary analysis of the fireball-growth films indicates the following yield values: Mike Shot, 12 ± 2 Mt; King Shot, 570 ± 30 kt. (See footnote on p. 7.)

The King Shot burst position was determined to be: Calculated error in position, 570 ± 35 ft; height of burst, 1480 ± 20 ft.

2.4 PROGRAM 4, NEUTRON MEASUREMENTS

Program 4 was primarily devoted to the measurement of total numbers of neutrons, in various known energy ranges, arriving at fixed points on the ground. Such neutron counting is accomplished by laboratory analysis of the neutron-induced radioactivity in selected threshold-detector materials such as gold, tantalum, indium, iodine, and zirconium. For each shot many detector stations were established in radial lines extending outward from bomb zero.

In addition, an attempt was made to measure the total number of neutrons arriving at a few selected points as a function of time, utilizing a device known as the "fission-catcher camera." The basic difference between these two measurements should be noted. The first allows only a counting of neutrons and gives no information as to when a particular neutron arrived, whereas the second does allow such a time separation.

Since the detector-station positions for Mike Shot were selected on the basis of an expected relatively low yield, many of the samples were lost. However, 35 samples were recovered, some from within the weapon crater, and are being analyzed at the present time. Thirty-eight of the King Shot samples were recovered and are also undergoing analysis. All the fission-catcher cameras were destroyed by the blast.

Incidentally, the relatively large amount of measurement-station destruction (and resulting potential data loss) suffered by this program is not indicative of a poorly designed experiment. The high attenuation of a neutron signal passing through air dictates that such stations must be relatively near the bomb, and the value of such close-in data is well worth the risk of losing an inexpensive station. Also, one of the great potential values of these neutron measurements is to explain why a device fizzled or detonated with a yield much lower than predicted.

2.5 PROGRAM 5, GAMMA-RAY MEASUREMENTS

This program was another of those devoted to studying the phenomenology of the device tested. Measurements were made of the gamma-ray intensity as a function of both time and distance, including that due to fall-out, and of the total gamma-ray dose as a function of distance. The close-in instrumentation was also designed for diagnostic studies and a study of shock-wave effects on gamma radiation. The more distant instrumentation was concerned largely with fall-out and included utilization of several newly developed collection and recording devices.

Total dose was measured with film badges on both shots, many badge stations being established on radial lines extending from bomb zero. Close-in intensity vs time (one ten-millionth of a second time resolution) was measured with phosphor-photocell—oscilloscope-camera combinations for the first few seconds. More distant intensity vs time measurements (a few seconds time resolution) were made with ionization-chamber–recorder combinations. Fall-out samples were collected over both land and water at selected points ranging from a few to several hundred miles from bomb zero.

On Mike Shot nearly all the film badge stations were destroyed. Meager data will be extracted from those more than 4500 yd from zero, however. High time-resolution intensity records were obtained in sufficient quantity to indicate the pronounced effect of the shock wave and to measure the time between the two fission phases of the device. Lower time-resolution intensity records were obtained on seven islands of Eniwetok Atoll. Thus far no such data have been recovered from the off-atoll stations, although fall-out has been recorded on Kusaie and Ujelang Atolls. Usable fall-out samples (some of them as a function of time) were collected on the islands of Eniwetok Atoll, on rafts within the lagoon, on buoy-type sea stations, and at other atolls. It is expected that an analysis of these samples and the ionization-chamber–recorder data will definitely augment the understanding of the over-all fall-out hazard problem, particularly because of the time dependence of portions of the data.

On King Shot the film-badge stations out to 1200 yd were destroyed, apparently by a large block of concrete which rolled down the line, wrecking both film-badge and neutron-detector stations. The remainder of the badges were recovered and are undergoing analysis. Usable intensity vs time data were obtained with both slow and fast time resolution. It is interesting to note that the peak radiation level on Runit (2000 yd from zero) was 5000 r/hr 5 sec after zero and had dropped to $\frac{1}{2}$ r/hr approximately 1 min later. No significant fall-out was recorded on any other island of the atoll, and none had been reported at any off-atoll station at the time of writing. Samples were obtained from 24 fall-out collector stations on islands of the atoll. These samples exhibited extremely low activity, however, indicating very slight to no fall-out.

2.6 PROGRAM 6, BLAST MEASUREMENTS

This program was designed to study the characteristics of the Mike and King blast waves; their propagation through air, water, and earth; and their transient effects on those media. In particular, data were sought to document the following:

1. Pressure vs time as a function of distance from zero at the surface.
2. Material velocity behind the shock front at known positions in space.
3. Shock wind, afterwind, and sound velocity before, during, and after blast-wave passage.
4. Water-surface motions in both deep and shallow water.
5. Subsurface earth accelerations.
6. Subsurface pressures in both deep and shallow water, including acoustic pressure waves at great distances.
7. Air density vs time before, during, and after shock-wave passage.
8. Free-air pressure vs time at known positions in space.

The tremendous energy release associated with Mike Shot and the quasi-operational nature of the King Shot airdrop assured that great interest would be shown in this program by both the AEC and the DOD.

The experimental techniques utilized to obtain the above-mentioned data were too many and too varied to allow description in a summary of this type. As an example, they included tiny self-recording indenter gauges and completely instrumented bomber-type aircraft.

Many usable data were obtained, every project reporting at least partial success in its cursory report, in spite of unforeseen difficulties due to inclement weather. Some tentative conclusions that can be drawn are as follows:

1. The basic blast pattern from nuclear explosions now appears to be established on quite firm theoretical and empirical grounds, in a self-consistent theory beginning with the growth of the fireball and extending to pressures less than 1 psi.

2. Atmospheric inhomogeneities markedly affect the blast variables at great distances for large-yield weapons. In particular, under normal temperature-lapse-rate conditions the peak pressures at great distances are markedly reduced.

3. Blast hydrodynamics offers considerable immediate promise as a diagnostic tool on tests of atomic weapons.

The following isolated facts of interest have resulted from preliminary inspection of the data:

1. Water-surface displacement was 2 to 4 ft at Runit Island and 1 to 3 ft at Parry Island for Mike Shot. The waves produced by this shot were in general much smaller than predicted, being approximately one-tenth of those expected within the lagoon and nonexistent in the open sea.

2. A newly devised light and inexpensive deep-sea mooring, which utilizes the top of undersea mountains rising to some 5000 ft under the surface, was proved highly successful. This ability to establish semirigid reference points in mid-ocean may well offer a valuable contribution to ocean studies in general.

3. The B-36D horizontal tail bending moment was approximately 62 per cent of design limit, although in the wing the bending moments due to gust were very low. At shock arrival this aircraft was approximately 24 nautical miles from bomb zero at an altitude of 40,000 ft. The preliminary conclusion implied is that the B-36D will not be capable of delivering a megaton bomb without an aid (drone or drogue) of one type or another.

4. Identical peak pressures of 0.36 psi were measured on Parry Island for Mike and King Shots. This anomaly appears to be due to a refraction effect.

2.7 PROGRAM 7, LONG-RANGE DETECTION

Program 7 was designed to aid in the development of, and obtain calibration data for, specialized equipment and techniques for the detection (and analysis, to whatever degree is feasible) of a nuclear explosion at great distances. The techniques utilized were extremely diverse in nature, covering the fields of electromagnetic radiation transport, air-borne low-frequency sound, seismic-wave propagation, and the detection of fireball light, as well as the tracking, collection, and analysis of air-borne bomb debris samples.

The quantity and general characteristics of the data and samples collected in this program are indicative of a successful operation, but practically no data have been reduced and analyzed in detail at the time of writing. Existing cloud-cover and smoke observations make the bhangmeter results appear questionable, however, final conclusions must await film analysis. Communication difficulties lessened the effectiveness of the King Shot air-sampling operations, but the samples obtained are adequate for at least partial analysis. The Mike Shot air sampling was more successful. Most of the remote stations report reception of excellent signals in conjunction with Mike Shot. For King Shot no reports have yet been received from these stations, but no difficulty is anticipated.

2.8 PROGRAM 8, THERMAL-RADIATION MEASUREMENTS

The thermal radiation emitted by an atomic detonation represents still another subject for investigation. The projects of Program 8 were each designed to document a particular aspect of this phenomenon. Near the surface of the earth attempts were made to measure the total thermal energy received as a function of distance from bomb zero, the time variation of the thermal intensity received, and the energy spectrum exhibited by this radiation. In conjunction with these measurements the atmospheric attenuation (transmission property) along light paths of interest was studied in order to aid in the interpretation of results. Instrumented bomber-type aircraft were also employed to study, in free air and at altitudes significant to delivery aircraft, the thermal intensity vs time and the associated radiation-induced aircraft-skin temperatures. The latter information is clearly essential to studies of safe aircraft delivery techniques. The instrumentation utilized to accomplish the thermal-radiation measurements included thermocouples, bolometers, photocell-recorder combinations, high-speed spectrographs, and skin patches.

Results were, in general, most gratifying, the only serious loss of data occurring in the thermal-radiation project for King Shot. Many data, the quality of which appears to be excellent, were obtained on both shots. A cursory analysis points out the following facts of more or less general interest:

1. The apparent thermal energy of Mike Shot was at least 0.7 Mt. This value is uncorrected for clouds and dust and hence is somewhat low.

2. On Mike Shot the left wing access door of the B-36D experienced a temperature rise of 93°F. The thickness of the aluminum was 0.025 in., and the aircraft was approximately 15 nautical miles from zero at an altitude of 40,000 ft. This aircraft received a relatively high thermal flux of 46.9 Btu/sq ft. The predicted value based on a 6-Mt yield was 36 Btu/sq ft.

3. The apparent thermal energy of King Shot was at least 48 kt.

2.9 PROGRAM 9, ELECTROMAGNETIC PHENOMENA

This program was concerned with the detection and measurement of various electromagnetic phenomena associated with nuclear detonations. The purpose of one project was a study of the correlation between nuclear-explosion-induced ionospheric disturbances and the interruption of radio communications. Another project was a feasibility study of radar-scope photography as an indirect bomb damage assessment (IBDA) technique. In addition, two projects were concerned with documentation of the broad-band electromagnetic signal given off by the exploding devices. Selected standard radio-frequency (20-kc and 4.215-Mc) bands were of particular interest in one of these projects; the other project was designed to test the feasibility of this technique for making remote diagnostic measurements, and hence the particular interest here was in the early (first few millionths of a second) signal characteristics.

The techniques used to obtain data for the detection and measurement of electromagnetic phenomena included air-borne radar-scope photography, the reception and recording of selected radio transmission, and the documentation of ionospheric height and continuity. Quantitative measurements of the gross explosion-induced electromagnetic signal were made possible by first displaying portions of that signal on the faces of cathode-ray tubes.

The results of these efforts were excellent. All projects obtained usable data on both shots, the detailed reduction of which is being carried out at present. On Mike Shot the early electromagnetic signal was displayed in sufficient detail to allow a rough measurement of the time delay between primary and secondary fission reactions. A Navy P2V flying 200 miles west of Eniwetok and transmitting a continuous-wave signal to Bikini was able to contact Bikini shortly after M+2 hr, indicating no long-time disruption of the ionosphere. Also, for this shot, the radar-scope photographs show both fireball growth and shock progress.

2.10 PROGRAM 10, TIMING AND FIRING

The timing and firing program was primarily one of support rather than experimentation. As its name implies, this program consisted in furnishing the various experimental projects with the required timing signals (for starting equipment, etc.) on both shots and supplying the arming and firing signals to the Mike device. In addition, vital information was telemetered from the vicinity of the Mike device to the control room aboard the USS Estes.

For Mike Shot the master timing equipment was located on the shot island near zero. Radio controls were used to give manually started signals and to start the sequence timer. This same radio system could also be used to stop the shot at any time before zero time. The following signals were sent by wires to the various experimenters: −30, −15, −5, and −1 min; −30, −15, −5, and −1 sec. The earliest signal was sent manually, and all later signals were sent by cam-operated switches on a sequence timer. This timer was manually started at the proper time before the −15 min signal was due and ran through its cycle automatically. Two independent television channels between the shot island and the ship were used for telemetering. The two cameras were focused on identical indicator panels, which showed the information required by the Firing Party Commander in determining whether or not the detonation would take place in an acceptable fashion.

For King Shot, time signals were available at −30, −15, and −5 min and at −30, −15, −5, −2.5, and −1.5 sec. Zero time signals were furnished by individual Blue Boxes located near the equipment with which they were used. The first three signals were sent manually, and all later signals were sent from an automatic timer. This timer was started by a radio signal from the drop plane when the bomb was dropped. Manual signals were based on the estimated bomb release time, and automatic signals were based on the time of fall of the bomb. Blue Boxes were triggered by the sharp rise in light from the explosion.

With the exception of a number of Blue Boxes which failed to trigger on Mike Shot, this program can be considered highly successful. A complete photographic record of the Mike Shot television monitoring was obtained.

2.11 PROGRAM 11, PRELIMINARY GEOPHYSICAL AND MARINE SURVEY OF THE TEST AREA

This program was designed to obtain detailed information as to the configuration and structure of Eniwetok Atoll in order that the effects of Mike Shot (and other high-yield shots presently planned for future tests) on that structure might be more readily and reliably interpreted. In addition, it included a study of the biological contamination effects resulting from atomic bursts near water.

Prior to Mike Shot, both acoustic soundings and seismic-refraction surveys were conducted on and around the Eniwetok reef. Ground shock tests were accomplished in conjunction with HE detonations, and two deep-drill holes were sunk to unaltered basement rock. In addition, samples of marine life were collected both before and after the shot in order that the biological effects of radiation contamination might be subsequently analyzed in the laboratory.

The only appropriate preliminary statement of results for this program is that usable data were recovered and are being reduced.

Note: Later work has shown that the radiochemical yield results for Mike Shot quoted in Sec. 2.1 are too low. The reason for this is that it has been found that the uranium content in coral varies markedly with coral depth. Since a considerable part of the uranium in post-shot debris came from associated coral, the resulting error was large. Although it has not been possible to make a good correction for the coral uranium contribution, a rough correction indicates that the radiochemical results are not inconsistent with the ball-of-fire yield, and the latter can be considered to be correct.

and telephonic nets when available. During each recovery or work phase, the monitor constantly kept track of the accumulating dosage with pocket dosimeters and through calculations, using the readings obtained on the AN/PDR-T1B. Some of the results of aerial and ground surveys are shown in Table 3.1. The ground values given in the table are indicated by daggers, and, unless otherwise stated, the aerial values are from an altitude of 25 ft.

Table 3.1—RADIATION LEVELS, FROM AERIAL AND GROUND SURVEYS, IN MILLIROENTGENS PER HOUR

	Runit	Biijiri	Engebi	Teiteir	Ruchi	Bogallua
M-day	5–5,000 at 1,200 ft (Max)†	None recorded; 8,000 over Piiraai	50,000 at 500 ft	None recorded; 10,000 at 500 ft over Bogon	None recorded	7,000 at 1,500 ft
M+3	40–120†	2,000†	3,300 8,000†	18,000 10,000 on lagoon reef	9,000 26,000 on lagoon reef off Cochiti	10,000
M+8	12–16	400†	1,400 2,500†	3,400 8,000†	1,300 2,500†	1,300 2,800†
M+14	0–40†	130 270†	600 1,400†	1,900	800	850
K-day	0–3,800 (3,800 over north end; 3–5 south of airstrip)†	120 200†	480	2,400	400	750
K+1	1.0 1.0† South 10 Center 100	70 150†	430 900†	1,600	420	440

(a) Ujelang Evacuation. This evacuation was accomplished utilizing the LST 827, commencing on 27 October 1952, and re-entry was accomplished on 2 November 1952. TU 7 loaned personnel to CINCPAC to ensure that all necessary radiological-safety precautions were taken. The evacuation was carried out in a successful manner, and no radiological hazards were encountered.

(b) Horizon Radiological Safety. Radex had shown the possibility of the Horizon being subjected to some fall-out. The data which this vessel was to collect were essential, and the vessel had to be "on station." The radiological-safety-responsible agency was TG 132.3. The interest of TU 7 in the operation lay in the furnishing of radiological-safety personnel and equipment to accomplish the radiological-safety activities. This craft, which had been 72 miles north northeast of zero, reported contact with the fall-out area. Within 20 min after the